AIRS/AMSU/HSB Version 5 Calibration Subset Quick Start

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Introduction

The Calibration Subset Product aids in verifying the calibration of AIRS, AMSU and VIS channel radiances relative to truth on the Earth's surface.

Each file covers a 24-hour period from midnight to midnight UTC, and for certain spots during that day extracts AIRS IR and VIS radiances, AMSU-A brightness temperatures, and AVN predicted sea surface temperatures. AMSU-A data are interpolated to the location of the AIRS footprint. For the VIS data, only the mean and the standard deviation of the 8x9 pixel grid are saved.

The file contains information associated with AIRS footprints selected if they match any of the following criteria:

- A footprint is determined to be cloud-free according to a series of tests.
- The center of a footprint lies within 30 nautical miles of one of 20 calibration sites. The sites were chosen for a diversity of local and provide continuous atmospheric and surface observations. Key sites are Dome Concordia, Antarctica Automatic Weather Station (AWS 8989), ARM-Cart sites at Southern Great Plains and North Slope Alaska and Tropical Western Pacific, French SPOT desert calibration site in Egypt, AMSR-E tropical rainforest site in Boumba Cameroon, and Surgut, Siberia.
- A footprint contains very high clouds and is within |lat| ≤ 60°.

Figure 1: Calibration Sites (those at North and South poles are not shown)

In addition, isolated near-nadir footprints are selected at random in such a way that a globally balanced coverage is achieved. (Regular sampling would over-represent polar regions.)

The output file is organized in two separate pseudo-swaths called "L1B_AIRS_Cal_Subset" and "L1B_AIRS_Cal_Subset_Gran_Stats".

"L1B_AIRS_Cal_Subset" contains the bulk of the data. It is not a true "swath" of complete scans, each containing a fixed number of footprints. Instead, individual footprints are selected, in time order, from scans covering multiple granules.

"L1B_AIRS_Cal_Subset_Gran_Stats" contains a number of statistics on a per-granule basis. It covers 241 granules - 239 full granules of the subject day, plus those portions of the preceding and following granules that lie within the subject day (between 00:00:00.000 and 23:59:59.999).

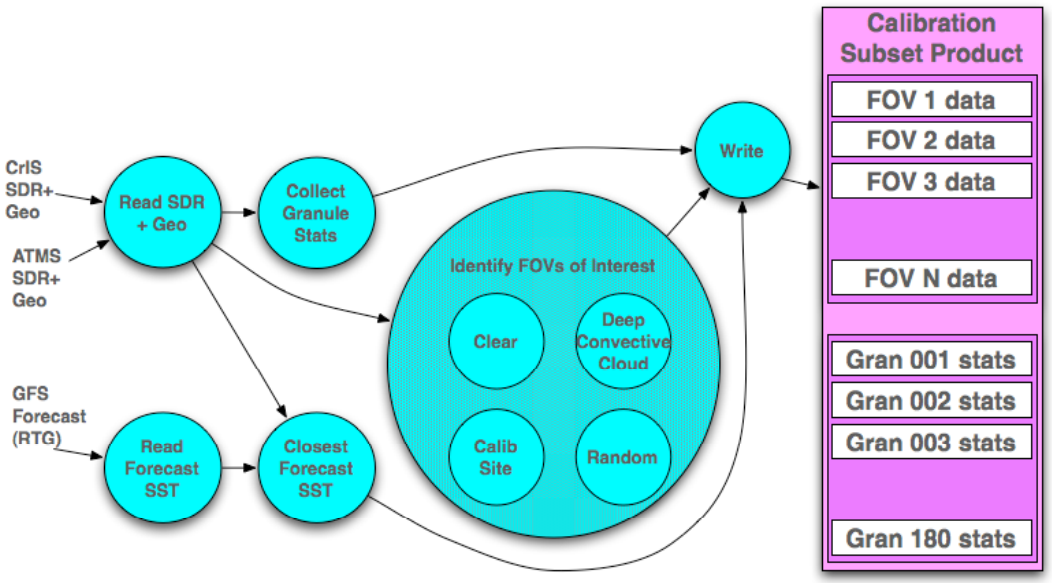
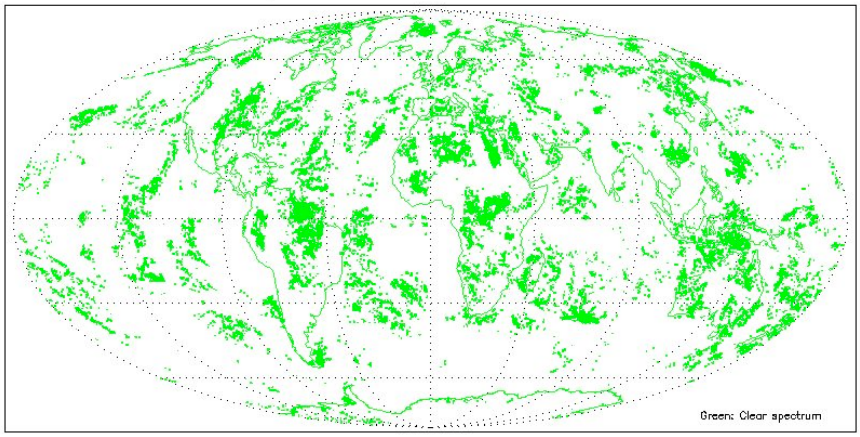
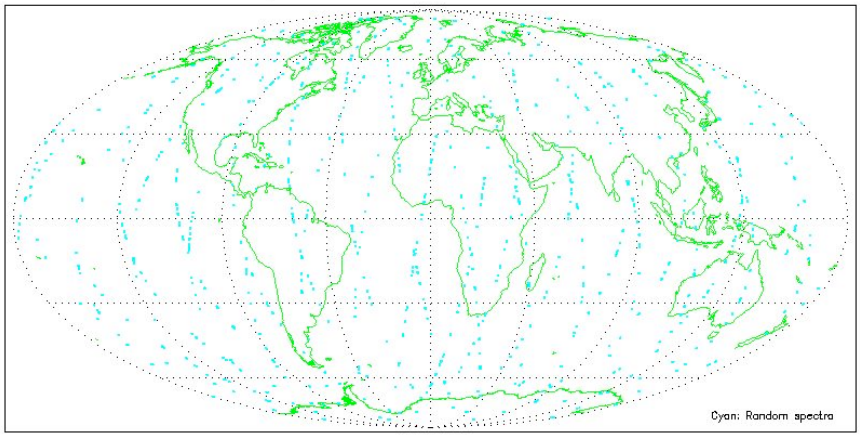


Figure 2: Schematic of Calibration Subset Data

The following example is a calibration subset product file for December 3, 2009.

Daily Product Dec 3, 2009 processed using AIRS and AMSU radiances:
Name: AIRS.2009.12.03.L1B.Cal_Subset.v5.0.16.0.G2002123120634.hdf
Shortname: AIRXBCAL





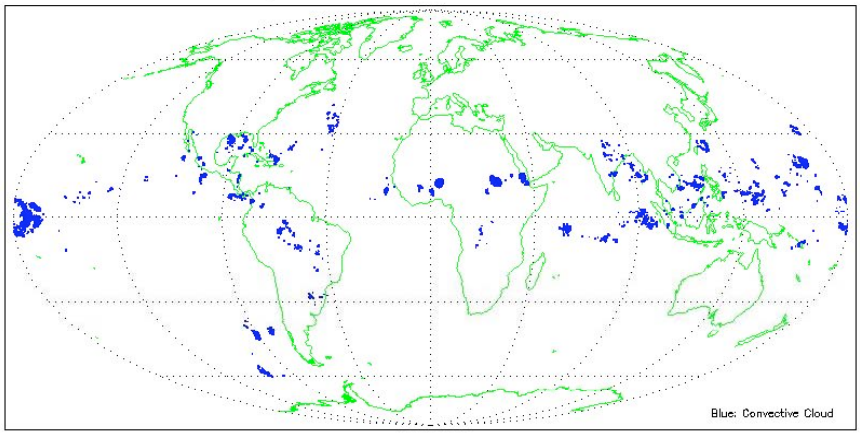


Figure 3: Sample data locations for Sept 9, 2002
Top: cloud-free Middle: locations chosen at random Bottom: convective cloud

Contents of Swath L1B_AIRS_Cal_Subset

Dimensions

Name	Value	Explanation
GeoTrack	variable	The number of CalSubset footprints contained in swath L1B_AIRS_Cal_Subset (equal to attribute "fp_count").
IR_Channel	2378	The number of AIRS IR channels. Frequencies are given in field nominal_freq.
VIS_Channel	3	The number of VIS channels. Channel 1: ~0.4 micron Channel 2: ~0.6 micron Channel 3: ~0.8 micron (The VIS/NIR instrument also has a 4th broadband channel, but that is not used here.)
AMSU_Channel	15	The number of AMSU-A channels. Channel 1: 23.8 GHz Channel 2: 31.4 GHz Channel 3: 50.3 GHz Channel 4: 52.8 GHz Channel 5: 53.596 +/- 0.115 GHz Channel 6: 54.4 GHz Channel 7: 54.94 GHz Channel 8: 55.5 GHz Channel 9: f0 Channel 10: f0 +/- 0.217 GHz; Channel 11: f0 +/- df +/- 48 MHz Channel 12: f0 +/- df +/- 22 MHz Channel 13: f0 +/- df +/- 10 MHz Channel 14: f0 +/- df +/- 4.5 MHz Channel 15: 89 GHz f0 = 57290.344 MHz df = 322.4 MHz

Attributes

Name	Number of Occurrences or Dimensions	Data Type	Explanation
CF_Version	1	char-8	Cloud Filter Version Identification Collectively identifies the set of thresholds used for cloud filtering and the distinction between day/night and land/water. The individual thresholds values are given in Table 6.
start_year	1	int-32	Start Year (eg. 2007) This field and the date and time fields following reflect the date/time of the earliest possible footprint that may be found in the output file.
start_month	1	int-32	Start Month (1-12)
start_day	1	int-32	Start Day of the Month (1-31)
start_hour	1	int-32	Start Hour
start_minute	1	int-32	Start Minute
start_sec	1	int-32	Start Second
fp_count	1	int-32	Footprint Count Total count of footprints
Clear	1	int-32	“Clear” Footprint Count Count of footprints selected by the “cloud-free” thresholds (Selection Algorithm #1) - total for day/night and land/water
Clear_DL	1	int-32	“Clear” Footprint Count - day/land The distinction between spacecraft day and spacecraft night is based on the solar zenith angle (the angle at the center of a footprint between zenith and the sun) and a day/night threshold angle (near 90°). The distinction between “land”, “water” and “coast” is based on

			the fraction of land (between 0.0 and 1.0) seen in a FOV and two threshold values (near 0.01 and 0.99). The threshold values are input arguments to the Clear Match PGE.
Clear_DW	1	int-32	“Clear” Footprint Count - day/water
Clear_NL	1	int-32	“Clear” Footprint Count - night/land
Clear_NW	1	int-32	“Clear” Footprint Count - night/water
CalSite	1	int-32	Calibration Site Footprint Count Count of footprints selected from calibration sites (Selection Algorithm #2) - total for day/night and land/water
CalSite_DL	1	int-32	CalSite Footprint Count - day/land
CalSite_DW	1	int-32	CalSite Footprint Count - day/water
CalSite_NL	1	int-32	CalSite Footprint Count - night/land
CalSite_NW	1	int-32	CalSite Footprint Count - night/water
HiCloud	1	int-32	High Clouds Footprint Count Count of footprints viewing high clouds over non-polar regions (Selection Algorithm #3) - total for day/night and land/water
HiCloud_DL	1	int-32	High Clouds Count - day/land
HiCloud_DW	1	int-32	High Clouds Count - day/water
HiCloud_NL	1	int-32	High Clouds Count - night/land
HiCloud_NW	1	int-32	High Clouds Count - night/water
Random	1	int-32	Random Footprint Count Count of nadir footprints selected at random (Algorithm #4) - total for day/night and land/water (Actually only the center footprint of a 9-footprint “golfball” is selected at random. The surrounding 8 footprints are then

			added.)
Random_DL	1	int-32	Random Count - day/land
Random_DW	1	int-32	Random Count - day/water
Random_DC	1	int-32	Random Count - day/coast
Random_NL	1	int-32	Random Count - night/land
Random_NW	1	int-32	Random Count - night/water
Random_NC	1	int-32	Random Count - night/coast

Geolocation

These fields exist for every footprint selected.

Name	Data Type	Explanation
Latitude	float-64	Footprint Latitude degrees North (-90.0 to 90.0)
Longitude	float-64	Footprint Longitude degrees East (-180.0 to 180.0)
Time	float-64	Footprint Time TAI (elapsed seconds since January 1, 1993 00:00Z UTC)

Data Fields Appearing Once

The following data fields are produced once:

Name	Number of Occurrences or Dimensions	Data Type	Explanation
nominal_freq	IR_Channel	float-32	Nominal IR Channel “Frequencies”, (cm^{-1})

Data Fields Associated with Every Footprint

These fields exist for every footprint selected.

Name	Number of Occurrences or Dimensions	Data Type	Explanation
granule_number	GeoTrack	int-16	The granule from which the footprint was selected (range: 0 - 240). "0'' identifies Granule 240 of the preceding day.
scan	GeoTrack	int-16	Scan number (range: 1 - 135)
footprint	GeoTrack	int-16	Footprint number (range: 1 - 90)
reason	GeoTrack	int-16	Footprint Selection Reason. Identifies the reason for the footprint's selection as follows: 1 = Clear (cloud-free) location 2 = Calibration site identified by field "site". 4 = High clouds 8 = Randomly selected location Note: Footprints may be selected for more than one reason. In that case the reason codes are combined (bitwise or'd).
site	GeoTrack	int-16	If the footprint was selected because it is near a calibration site (reason = 2), this field identifies the site as follows: 0 = footprint selection reason is not "calibration site" 1 = Egypt 1 Lat: 27.12°N, Lon: 026.10°E 2 = Simpson Desert Lat: 24.50°S, Lon: 137.00°E 3 = Dome Concordia

			Lat: 75.10°S, Lon: 123.40°E 4 = Mitu, Columbia Lat: 01.50°N, Lon: 069.50°W 5 = Boumba, Cameroon Lat: 03.50°N, Lon: 014.50°E 6 = Railroad Valley, NV Lat: 38.50°N, Lon: 115.70°W 7 = SPG/Arm-Cart, OK Lat: 36.60°N, Lon: 97.50°W 8 = Manus, Bismarck Archipelago Lat: 02.00°S, Lon: 147.40°E 9 = Nauru, Micronesia Lat: 00.50°S, Lon: 166.60°E 10 = North Pole Lat: 90.00°N, Lon: N/A 11 = South Pole Lat: 90.00°S, Lon: N/A 12 = Surgut, Siberian tundra Lat: 61.15°N Lon: 73.37°E 13 = Yunnan rain forest Lat: 23.90°N Lon:100.50°E 14 = Barrow, Alaska Lat: 71.32°N Lon:156.66°W 15 = Atqusuk, Alaska Lat: 70.32°N Lon:156.67°W 16 = Darwin, Australia Lat: 12.42°S Lon:130.89°E

			17 = Lake Qinghai, China Lat: 36.75°N Lon:100.33°E 18 = Dunhuang, Gobi desert Lat: 40.17°N Lon: 94.33°E 19 = Lake Titicaca Lat: 15.88°S Lon: 69.33°W 20 = Lake Tahoe, CA Lat: 39.10°N Lon: 120.04°W
scan_node_type	GeoTrack	char	Node Type Consists of a single character: “A” = ascending node (day) “D” = descending node (night) “N” = north pole “S” = south pole “Z” = not available
satzen	GeoTrack	float-32	Satellite Zenith Angle Angle between satellite and zenith at footprint location in degrees [0.0, 90.0] -9999.0 means “not available”.
solzen	GeoTrack	float-32	Solar Zenith Angle Angle between sun and zenith at footprint location in degrees [0 .0, 180.0] -9999.0 means “not available”.
topog	GeoTrack	float-32	Mean elevation or “topography” at the center of the reference ellipsoid, in units of meters above mean sea level. -9999.0 means “not available”.
satheight	GeoTrack	float-32	Satellite altitude above nadir in km. -9999.0 means “not available”.
sun_glint_distance	GeoTrack	int-16	Distance, in km, from footprint center to the location of the sun glint during the sunlit portion of the orbit. “30000” indicates the spacecraft is in the earth’s

			shadow. -9999 means “not available”.
LandFrac	GeoTrack	float-32	Land Fraction Fraction of surface identified to be land [0.0, 1.0] -9999.0 means “not available”.
radiances	GeoTrack * IR_Channel	float-32	AIRS IR radiances for each channel for the selected footprint. Given in units of mW / m2 / cm-1 / steradian -9999.0 means “not available”.
VisMean	GeoTrack * VIS_Channel	float-32	Mean Radiances - VIS Channels This is the mean of the 72 samples for VIS channels 1 - 3. Given in units of W / m2 / μm / steradian -9999.0 means “not available”.
VisStdDev	GeoTrack * VIS_Channel	float-32	Standard Deviation - VIS Channels This is the standard deviation of the 72 samples for VIS channels 1 - 3. -9999.0 means “not available”.
avnsst	GeoTrack	float-32	Sea Surface Temperature derived from the nearest (in time) two of six 3-hour Aviation Forecasts. The forecast times are T21Z of the previous day, T03Z, T09Z, T15Z, T21Z, and T03Z of the next day. The forecasts give the temperatures for a 1-degree grid. The derived temperature (K) is interpolated 1. for latitude 2. for longitude 3. for time -9999.0 means “not available”.
cx2616	GeoTrack	float-32	Output of the spatial coherence test at 2616 cm-1. For cloud-free data cx2616 < 0.7K over water and

			cx2616 < 2.0 K over land. -9999.0 means “not available”.
cx1231	GeoTrack	float-32	Output of the spatial coherence test at 1231 cm-1. Given in K. For cloud-free data cx1231 < 10.0 K -9999.0 means “not available”. See Note 1, below.
cx2395	GeoTrack	float-32	Output of the spatial coherence test at 2395 cm-1 Given in K. -9999.0 means “not available”. See Note 1, below.
cxq2	GeoTrack	float-32	Output of the spatial coherence test for total water vapor, using the bt2616 - bt2607 proxy Given in K. For cloud-free data cxq2 < 1.0 K -9999.0 means “not available”. See Note 1, below.
cxlpn	GeoTrack	float-32	Output of the spatial coherence test for the pseudo lapse rate lp, where: lp = (bt2395-bt2392) * (cos sza)0.3, where sza is the satellite zenith angle, Given in K. -9999.0 means “not available”. See Note 1, below.
bt1231	GeoTrack	float-32	Brightness Temperature - 1231 cm-1 in K. -9999.0 means “not available”.
sst1231r5	GeoTrack	float-32	Surface Temperature - 1231 cm-1 This is the surface skin temperature (day and night) for surfaces with emissivity 0.98. This is a good approximation at 1231 cm-1 for non-frozen water,

			land surfaces covered by vegetation, snow and ice. Calculated per footprint as: sst1231r5 = bt1231 + 0.28 + (1.2 * q3) + (0.2962 * q3)2 + (1.0489 / cos(sza)) where: q3=bt1231-bt1227 and sza is the scan zenith angle. Given in K. -9999.0 means “not available”. Validated to 0.5K over liquid water.
lp2395clim	GeoTrack	float-32	Pseudo lapse rate threshold applied in testing for cloud-free conditions.
amsu_bt	GeoTrack * AMSU_Channel	float-32	AMSU-A antenna temperatures in K. (Note: When the AMSU-A L1B data set includes side-lobe corrected antenna temperatures, as planned for Version 5, this field will reflect those corrected temperatures.) -9999.0 means “not available”. Interpolated from 45 X 30 footprint AMSU-A swath to 135 X 90 footprint AIRS swath.
amsu_topog	GeoTrack	float-32	Mean elevation or “topography”, in units of meters above mean sea level. -9999.0 means “not available”. Interpolated from 45 X 30 footprint AMSU-A swath to 135 X 90 footprint AIRS swath.
amsu_landFrac	Geotrack	float-32	Land Fraction Fraction of surface identified to be land [0.0, 1.0] -9999.0 means “not available”. Interpolated from 45 X 30 footprint AMSU-A swath to 135 X

			90 footprint AIRS swath.
dust_flag	Geotrack	int16	Flag telling whether dust was detected in this scene; 1: Dust detected; 0: Dust not detected; -1: Invalid (due to land); -2: Invalid (due to high latitude); -3: Invalid (due to suspected cloud); -4: Invalid (due to bad input data)
BT_diff_SO2	Geotrack	float32	Brightness temperature difference BT(1361.44 cm-1) - BT(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2. -9999.0 means “not available”.

Note 1: Parameters cx1231, cx2395 test the spatial coherence at 1231 cm^{-1} and at 2395 cm^{-1}. Parameter cxq2 tests the spatial coherence of the total water (bt2616-bt2607), and parameter cxlpn tests the spatial coherence of the pseudo lapse rate (bt2395-bt2392). These test are used to identify how cloudy the special locations are which did not pass the cx2616<0.7K spatial coherence clear test.

Threshold Values for Cloud Filter

Name	Explanation	Values L = over land W = over water D = at day N = at night
th_solzen_day	solzen threshold to distinguish S/C day and night	day: < 90.0 night: => 90.0
th_landfrac_land	landfrac threshold to identify land	land: > .99
th_landfrac_ocean	landfrac threshold to identify water (coast if neither land nor water)	water: < .01
th_scor	spatial coherence threshold	L: < 2.0 W: < 0.7
th_2392	surface temperature difference threshold applied against the difference between sst1231r5 and sst2392r1	L: >-15.0 W: > -2.0
th_btq2	threshold applied against the bt2616 – bt2607 difference	> 0.1
th_cxq2	threshold applied against the most extreme among the 5-FOV bt2616 – bt2607 gradients	< 1.0
th_cx1231	threshold applied against the most extreme difference among the 5-FOV bt1231	< 10.0
th_g5n	threshold applied against the g5n quantity (glint-filtered bt2616 – bt2508 difference)	LD: < 6.0 WD: < 2.5 LN: < 1.2 WN: < 1.2
th_btg5n	minimum threshold for the g5n quantity	> 0.5

Additional thresholds for the pseudo lapse rate, based on geographical position, are obtained from ancillary files.

Contents of Swath L1B_AIRS_Cal_Subset_Gran_Stats

Dimensions:

Name	Value	Explanation
Grans_plus_1	241	The number of granules per day, plus 1.

The following data fields are produced once for each granule. For the first and last granules, which start on the preceding day and end on the following day, only the portion that lies within the current day (data day) is evaluated.

The individual fields are collected from groups of individual footprints differentiated as follows:

- Group 1 includes all AIRS IR footprints encountered in the input data stream that lie inside the "data day" and for which the "state" flag indicates "process".
- Group 2 includes all AIRS footprints of Group 1 that also match the day/night and land/water criteria established for the majority of a granule's footprints. (See fields mean_land_flag and mean_day_flag.)
- Group 2a includes all footprints of Group 2 representing "clear" FOV's
- Group 2b includes all footprints of Group 2 representing "high clouds"

Some of the values below are hypothetical counts of spectra that would have been selected as "clear", had different spatial coherence thresholds been selected. The nomenclature used in the "Explanation" field below is as follows:

- th is the applicable spatial coherence threshold. Its value for land and water are defined in Table 6 (see "th_scor")
- tht1 is the applicable threshold, tightened by one step (whereby one step is 0.2 over water and 0.5714 over land)
- thr1 is the applicable threshold, relaxed by one step
- thr2 is the applicable threshold, relaxed by two steps

Data Fields

Name	Sel. from Grp	Data Type	Extra Dimension	Explanation
center_latitude	1	float-64	None	Latitude of granule center (-90 to 90).
center_longitude	1	float-64	None	Longitude of granule center (-180 to 180).
mean_day_flag	1	int-16	None	Indicates whether the majority of AIRS footprints in the input data stream lies on the day or night side. 0 = night 1 = day -1 = unknown Note that this flag refers to footprints examined in the input data stream not footprints included in the output data stream (i.e. this file).
mean_land_flag	1	int-16	None	Indicates whether the majority of AIRS footprints in the input data stream lies over land or over water. 0 = water 1 = land -1 = unknown
cnt_in	2	int-16	None	Total number of AIRS footprints in the input data stream that form the majority (i.e. match both the mean_day_flag and the mean_land_flag)
cnt_clear	2a	int-16	None	Count of input majority footprints representing clear FOV's
cnt_hi_clouds	2b	int-16	None	Count of input majority footprints representing high clouds
cnt_cx2616_th_excl	2	int-16	None	Count of input footprints which pass the test (exclusively): cx2616 < th, where th is the applicable threshold value. Only this test is made. The other tests that normally must be passed to declare a footprint as "clear" are excluded.

cnt_cx2616_q2_th_excl	2	int-16	None	Count of input footprints which pass the tests (exclusively): cx2616 < th, q2 < th where th is the applicable threshold value
cnt_cx2616_tht1_excl	2	int-16	None	Count of input footprints which pass the test (exclusively): cx2616 < tht1, where tht1 is the applicable threshold value, tightened by one step
cnt_cx2616_q2_tht1_excl	2	int-16	None	Count of input footprints which pass the tests (exclusively): cx2616 < tht1, q2 < th where th is the applicable threshold value and tht1 is the threshold value, tightened by one step
cnt_cx2616_thr1_incl	2	int-16	None	Count of input footprints which would have passed all tests (inclusively), had the test: cx2616 < thr1, used a threshold value relaxed by one step
cnt_cx2616_q2_thr1_incl	2	int-16	None	Count of input footprints which would have passed all tests (inclusively), had the tests: cx2616 < tht1, q2 < th used a threshold value relaxed by one step
cnt_cx2616_thr2_incl	2	int-16	None	Count of input footprints which would have passed all tests (inclusively), had the test: cx2616 < thr1, used a threshold value relaxed by two steps
cnt_cx2616_q2_thr2_incl	2	int-16	None	Count of input footprints which would have passed all tests (inclusively), had the tests: cx2616 < tht1, q2 < th used a threshold value relaxed by two steps
sst1231_gfs_mean	2a	float-32	None	Difference between the surface skin temperature calculated using bt1231 and the predicted

				GFS SST – Mean
sst1231_gfs_stddev	2a	float-32	None	Difference between the surface skin temperature calculated using bt1231 and the predicted GFS SST - Standard Deviation
lp_mean	2a	float-32	None	Pseudo Lapse Rate - Mean
lp_stddev	2a	float-32	None	Pseudo Lapse Rate – Standard Deviation
q3_mean	2a	float-32	None	q3 – Mean where q3 is the difference between bt1231 and bt1227
q3_stddev	2a	float-32	None	q3 – Standard Deviation
bt1231_min	2	float-32	None	bt1231 - Minimum
bt1231_max	2	float-32	None	bt1231 - Maximum
bt1231_median	2	float-32	None	bt1231 - Median
lp_min	2	float-32	None	Pseudo Lapse Rate – Minimum
lp_max	2	float-32	None	Pseudo Lapse Rate – Maximum
lp_median	2	float32	None	Pseudo Lapse Rate - Median
d_sst1231_gfs_mean	2	float-32	None	abs(sst1231 – gfssst) - mean
cnt_d_sst1231_gfs_lt_2	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) < 2 K
cnt_d_sst1231_gfs_gt_5	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 5 K
cnt_d_sst1231_gfs_gt_10	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 10 K
cnt_d_sst1231_gfs_gt_20	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 20 K
cnt_d_sst1231_gfs_gt_30	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 30 K
cnt_d_sst1231_gfs_gt_40	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 40 K
cnt_d_sst1231_gfs_gt_50	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 50 K
cnt_d_sst1231_gfs_gt_60	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 60 K
cnt_d_sst1231_gfs_gt_70	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 70 K
cnt_d_sst1231_gfs_gt_80	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 80 K
cnt_d_sst1231_gfs_gt_90	2	int-16	None	Count of footprints having abs(sst1231 – gfssst) > 90 K
amsu_bt_mean	2	float-32	AMSU_ Channel	mean brightness temperature [K]

			(15)	for each AMSU-A channel
cnt_sun_glint	2	int-16	None	Count of footprints < 200 km distant from sun glint, which are valid (state = “process”) and have a maximum VIS Channel 3 radiance > 3000
CalChanSummary	1	uint-8	IR_ Channel (2378)	Summary of calibration related occurrences for each IR channel in this granule, as detailed by the following flags: Bit 7 (MSB): scene over/underflow; Bit 6: (value 64) anomaly in offset calculation; Bit 5: (value 32) anomaly in gain calculation; Bit 4: (value 16) pop detected; Bit 3: (value 8) noise out of bounds; Bit 2: (value 4) anomaly in spectral calibration; Bit 1: (value 2) Telemetry; Bit 0: (LSB, value 1) unused (reserved); If all flags are zero the channel was well calibrated for all scanlines
NeN	1	float-32	IR_ Channel (2378)	Noise-equivalent Radiances at 250K. Given in units of mW / m^2 / cm^{-1} / steradian